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SHORT GLOSSARY OF SPACE TERMS

Second Edition

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FOREWORD

This Second Edition of the *Short Glossary of Space Terms* is intended, like its predecessor published in March 1962, to be an authoritative compilation of brief definitions of technical terms frequently used by space technologists. Through the process of editorial refinement, the definitions differ somewhat from those in the 1962 edition, but the list of terms is quite similar. An attempt has been made to keep the list short and the definitions as nontechnical as possible. The sole source of the definitions in this new edition is the *Dictionary of Technical Terms for Aerospace Use*, published in 1965, but much detail, including mathematical notation, has been omitted from the *Glossary* entries.

For expanded definitions of the terms appearing here and for definitions of terms not included, the reader is referred to the aforementioned *Dictionary of Technical Terms for Aerospace Use* (NASA SP–7).

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aberration. **1.** In astronomy, the apparent angular displacement of the position of a celestial body in the direction of motion of the observer, caused by the combination of the velocity of the observer and the velocity of light. **2.** In optics, a specific deviation from perfect imagery, as, for example: spherical aberration, coma, astigmatism, curvature of field, and distortion.

ablating material. A material, especially a coating material, designed to provide thermal protection to a body in a fluid stream through loss of mass.

ablation. The removal of surface material from a body by vaporization, melting, chipping, or other erosive process; specifically, the intentional removal of material from a **nose cone** or **spacecraft** during high-speed movement through a planetary atmosphere to provide thermal protection to the underlying structure. See **ablating material.**

abort. **1.** To cut short or break off an action, operation, or procedure with an aircraft, space vehicle, or the like, especially because of equipment failure, as *to abort a mission, the launching was aborted.* **2.** An aircraft, space vehicle, or the like that aborts. **3.** An act or instance of aborting.

absolute temperature. Temperature value relative to **absolute zero.**

absolute zero. The theoretical temperature at which molecular motion vanishes and a body would have no heat energy; the zero point of the **Kelvin** and **Rankine** temperature scales.

absorption. **1.** The process by which radiant energy is absorbed and converted into other forms of energy. **2.** In general, the taking up or assimilation of one substance by another. See **adsorption.** **3.** In vacuum technology, gas entering into the interior of a solid.

acceleration. **1.** The rate of change of **velocity.** **2.** The act or process of accelerating, or the state of being accelerated. Negative acceleration is called *deceleration.*

accelerometer. A **transducer** which measures acceleration or gravitational forces capable of imparting **acceleration.**

accumulator. **1.** A device or apparatus that accumulates or stores up, as: **(*a*)** a contrivance in a hydraulic system that stores fluid under pressure; **(*b*)** a device sometimes incorporated in the fuel system of a gas-turbine engine to store up and release fuel under pressure as an aid in starting; **(*c*)** an electrical storage battery (British usage). **2.** In computer technology, a device which stores a number and upon receipt of another number adds it to the number already stored and stores the sum.

acoustic velocity (*symbol a*) **=speed of sound.**

acquisition. **1.** The process of locating the orbit of a satellite or trajectory of a space probe so that tracking or telemetry data can be gathered. **2.** The process of pointing an antenna or telescope so that it is properly oriented to allow gathering of tracking or telemetry data from a satellite or space probe.

acquisition and tracking radar. A radar that locks onto a strong signal and tracks the object reflecting the signal.

actinic. Pertaining to **electromagnetic radiation** capable of initiating photochemical reactions, as in photography or the fading of pigments.

active. **1.** Transmitting a signal, as *active satellite.* Antonym of *passive.* **2.** **=radioactive,** as *active sample.* **3.** **=fissionable,** as *active material.* **4.** Receiving energy from some source other than a signal, as *active element.*

adiabatic. Without gain or loss of heat.

adsorption. The adhesion of a thin film of liquid or gas to the surface of a solid substance. The solid does not combine chemically with the adsorbed substance.

aerobiology. The study of the distribution of living organisms freely suspended in the atmosphere.

aeroduct. A **ramjet** type of engine designed to scoop up ions and electrons freely available in the outer reaches of

the atmosphere or in the atmospheres of other spatial bodies, and by a **metachemical** process within the duct of this engine, expel particles derived from the ions and electrons as a propulsive jetstream.

aerodynamic heating. The heating of a body produced by passage of air or other gases over the body; caused by friction and by compression processes and significant chiefly at high speeds.

aerodynamics. **1.** The science that deals with the motion of air and other gaseous fluids, and of the forces acting on bodies when the bodies move through such fluids, or when such fluids move against or around the bodies, as *his research in aerodynamics.* **2. (a)** The actions and forces resulting from the movement or flow of gaseous fluids against or around bodies, as, *the aerodynamics of a wing in supersonic flight.* **(b)** The properties of a body or bodies with respect to these actions or forces, as, *the aerodynamics of a turrent or of a configuration.* **3.** The application of the principles of gaseous fluid flows and of their actions against and around bodies to the design and construction of bodies intended to move through such fluids, as *a design used in aerodynamics.*

aerodynamic vehicle. A device, such as an airplane, glider, etc., capable of flight only within a **sensible atmosphere** and relying on aerodynamic forces to maintain flight.

aeroelasticity. The study of the response of structurally elastic bodies to **aerodynamic** loads.

aeroembolism. **1.** The formation or liberation of gases in the blood vessels of the body, as brought on by a too-rapid change from a high, or relatively high, atmospheric pressure to a lower one. **2.** The disease or condition caused by the formation of gas bubbles (mostly nitrogen) in the body fluids. The disease is characterized principally by neuralgic pains, cramps, and swelling, and sometimes results in death. Also called *decompression sickness.*

aerolite. A **meteorite** composed principally of stony material.

aeronomy. The study of the upper regions of the atmosphere where ionization, dissociation, and chemical reactions take place.

aeropause. A region of indeterminate limits in the upper atmosphere, considered as a boundary or transition region between the denser portion of the **atmosphere** and **space.**

aerospace. (From *aero*nautics and *space.*) **1.** Of or pertaining to both the earth's **atmosphere** and **space,** as in *aerospace industries.* **2.** Earth's envelope of air and space above it; the two considered as a single realm for activity in the flight of air vehicles and in the launching, guidance, and control of ballistic missiles, earth satellites, dirigible space vehicles, and the like.

aerospace medicine. That branch of medicine dealing with the effects of flight through the atmosphere or in space upon the human body and with the prevention or cure of physiological or psychological malfunctions arising from these effects.

aerothermodynamic border. An altitude at about 100 miles, above which the atmosphere is so rarefied that the skin of an object moving through it at high speeds generates no significant heat.

aerothermodynamics. The study of **aerodynamic** phenomena at sufficiently high gas velocities that **thermodynamic** properties of the gas are important.

agravic. Of or pertaining to a condition of no **gravitation.** See **weightlessness.**

air breakup. The breakup of a test **reentry body** after reentry into the atmosphere.

airglow. The quasi-steady radiant emission from the upper atmosphere as distinguished from the sporadic emission of the auroras.

air shower. A grouping of cosmic-ray particles observed in the atmosphere; a **cascade shower** in the **atmosphere.** Also called *shower.*

air sounding. The act of measuring atmospheric phenomena or determining atmospheric conditions at altitude, especially by means of apparatus carried by balloons or rockets. See **sounding.**

albedo. The ratio of the amount of **electromagnetic radiation** reflected by a body to the amount incident upon it, often expressed as a percentage, as, *the albedo of the earth is 34%.*

alpha particle. A positively charged particle emitted from the nuclei of certain atoms during radioactive disintegration. The alpha particle has an atomic weight of 4 and a positive charge equal in magnitude to 2 electronic charges; hence it is essentially a helium nucleus (helium atom stripped of its two planetary electrons).

ambient (*symbol* ***a,*** used as a subscript). Surrounding; especially, of or pertaining to the environment about a flying aircraft or other body but undisturbed or unaffected by it, as in *ambient* air, or *ambient temperature.*

amplidyne. A special type of direct current generator used as a power **amplifier** in which the output voltage responds to changes in field excitation; used extensively in **servo systems.**

analog computer. A computing machine working on the principle of measuring, as distinguished from counting, in which the input data is analogous to a measurement continuum, such as linear lengths, voltages, resistances, etc., which can be manipulated by the computer.

angel. A radar **echo** caused by a physical phenomenon not discernible to the eye.

angstrom (*abbr* **A, Å**). A unit of length, used chiefly in expressing short wavelengths. It equals 10^{-10} meters or 10^{-8} centimeters.

annular eclipse. An **eclipse** in which a thin ring of the source of light appears around the obscuring body.

anomalistic period. The interval between two successive **perigee** passages of a **satellite** in orbit about a primary. Also called *perigee-to-perigee period.*

anoxia. A complete lack of oxygen available for physiological use within the body. Compare **hypoxia.**

antigravity. A hypothetical effect that would arise from cancellation by some energy field of the effect of the **central force field** of the earth or other body.

aphelion. That point in a solar **orbit** which is most distant from the sun.

apogee. **1.** That point in a **geocentric orbit** which is most distant from the earth. That orbital point nearest the earth is called *perigee.* See **geo.** **2.** Of a satellite or rocket: To reach its apogee (sense **1**), as in *the Vanguard apogees at 2,560 miles.*

areo. Combining form of Mars (Ares), as in *areography.*

artificial gravity. A simulated **gravity** established within a space vehicle by rotation or acceleration.

asteroid. One of the many small celestial bodies revolving around the sun, most of the orbits being between those of Mars and Jupiter. Also called *planetoid, minor planet.* See **planet.**

astro. A prefix meaning *star* or *stars* and, by extension, sometimes used as the equivalent of *celestial,* as in *astro*nautics.

astroballistics. The study of the phenomena arising out of the motion of a solid through a gas at speeds high enough to cause **ablation;** for example, the interaction of a meteoroid with the atmosphere.

astrobiology. The study of living organisms on celestial bodies other than the earth.

astrodynamics. The practical application of **celestial mechanics, astroballistics,** propulsion theory, and allied fields to the problem of planning and directing the **trajectories** of space vehicles.

astronaut. **1.** A person who rides in a space vehicle. **2.** Specifically, one of the test pilots selected to participate in Project Mercury, Project Gemini, Project Apollo, or any other U.S. program for manned space flight.

astronautics. **1.** The art, skill, or activity of operating **spacecraft.** **2.** In a broader sense, the science of space flight.

astronomical unit (*abbr* **AU**). **1.** A unit of length, usually defined as the distance from the earth to the sun, 149,599,000 kilometers. **2.** The unit of distance in terms of which, in the Kepler Third Law, $n^2a^3=k^2(1+m)$, the semimajor axis a of an elliptical orbit must be expressed in order that the numerical value of the Gaussian constant k may be exactly 0.01720209895 when the unit of time is the ephemeris day.

atmosphere. **1.** The envelope of **air** surrounding the earth; also the body of gases surrounding or comprising any **planet** or other celestial body. **2.** =**standard atmosphere.** **3.** (*abbr* **atm**). A unit of pressure equal to 14.7 pounds per square inch.

atomic clock. A timekeeping device controlled by the frequency of the natural vibrations of certain atoms.

attitude. The position or orientation of an aircraft, spacecraft, etc., either in motion or at rest, as determined by the relationship between its **axes** and some reference line or plane or some fixed system of reference axes.

aurora. The sporadic radiant emission from the **upper atmosphere** over middle and high latitudes. It is believed to be due primarily to the **emission** from nitrogen—atomic N *I* and N *II*, molecular N_2, and ionic N_2^+; atomic oxygen (O *I* and O *II*); atomic sodium (Na *I*); the hydroxyl radical (OH); and hydrogen. Compare **airglow.**

axis (*plural* **axes**). **1.** A straight line about which a body rotates, or along which its center of gravity moves (axis of translation). **2.** A straight line around which a plane figure may rotate to produce a solid; a line of symmetry. **3.** One of a set of reference lines for a **coordinate** system.

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azimuth. **1.** Horizontal direction or **bearing.** **2.** In navigation, the horizontal direction of a **celestial** point from a **terrestrial** point, expressed as the angular distance from a reference direction, usually measured from 0° at the reference direction clockwise through 360°. **3.** In astronomy, the direction of a celestial point from a terrestrial point measured clockwise from the north or the south point of the **meridian** plane. **4.** In surveying, the horizontal direction of an object measured clockwise from the south point of the meridian plane.

Azusa. A short-baseline, continuous-wave, phase comparison, single-station, tracking system operating at C-band and giving two **direction cosines** and **slant range** which can be used to determine space position and velocity.

backout. An undoing of things already done during a **countdown,** usually in reverse order.

backup. **1.** An item kept available to replace an item which fails to perform satisfactorily. **2.** An item under development intended to perform the same general functions of another item also under development performs.

ballistics. The science that deals with the motion, behavior, and effects of projectiles, especially bullets, aerial bombs, rockets, or the like; the science or art of designing and hurling projectiles so as to achieve a desired performance.

ballistic trajectory. The **trajectory** followed by a body being acted upon only by gravitational forces and the resistance of the medium through which it passes.

balloon-type rocket. A liquid-fuel **rocket,** such as Atlas, that requires the pressure of its **propellants** (or other gases) within it to give it structural integrity.

beam. **1.** A ray or collection of focused rays of radiated energy. **2.** A beam (sense **1**) of radio waves used as a navigation aid. **3.** =**electron beam.** **4.** A body, one of whose dimensions is large compared with the others, whose function is to carry lateral loads (perpendicular to the long dimension) and bending movements.

beam rider. A craft following a **beam,** particularly one which does so automatically, the beam providing the **guidance.**

binary notation. A system of **positional notation** in which the **digits** are coefficients of powers of the base 2 in the same way as the digits in the conventional decimal system are coefficients of powers of the base 10.

bionics. The study of systems, particularly **electronic** systems, which function after the manner of, or in a manner characteristic of, or resembling, living systems.

biopropellant. A rocket **propellant** consisting of two unmixed or uncombined chemicals **(fuel** and **oxidizer)** fed to the combustion chamber separately.

bird. A colloquial term for a **rocket, satellite,** or **spacecraft.**

bit. 1. An abbreviation of *b*inary dig*it*. **2.** A single character of a language employing only two distinct kinds of characters. **3.** A quantity of intelligence which is carried by an identifiable entity and which can exist in either of two states. **4.** A unit of **storage capacity;** the capacity in bits of a storage device is the logarithm to the base two of the number of possible states of the device. **5.** A **quantum** of information. **6.** Loosely, a mark.

black box. 1. In engineering design, a unit whose **output** is a specified function of the **input,** but for which the method of converting input to output is not necessarily specified. **2.** Colloquially, any unit, usually an electronic device such as an amplifier, which can be mounted in, or removed from, a rocket, spacecraft, or the like as a single package.

blackout. 1. A **fadeout** of radio communications due to ionospheric disturbances. **2.** A fadeout of radio and telemetry transmission between ground stations and vehicles travelling at high speeds in the atmosphere caused by signal attenuation in passing through ionized boundary layer **(plasma sheath)** and shock wave regions generated by the vehicle. **3.** A vacuum tube characteristic which results

from the formation of a **dielectric** film on the surface of the control grid. **4.** A condition in which vision is temporarily obscured by a blackness, accompanied by a dullness of certain of the other senses, brought on by decreased blood pressure in the eye and a consequent lack of oxygen, as may occur; e.g., in pulling out of a high-speed dive in an airplane.

blockhouse, block house. **1.** A reinforced concrete structure, often built underground or half underground, and sometimes dome shaped, to provide protection against blast, heat, or explosion during rocket launchings or related activities; specifically, such a structure at a **launch site** that houses electronic control instruments used in launching a rocket. **2.** The activity that works in such a structure.

boilerplate model. A metal copy of a flight vehicle, the structure or components of which are heavier than the flight model.

boiloff. The vaporization of a liquid, such as liquid oxygen or liquid hydrogen, as its temperature reaches its **boiling point** under conditions of exposure, as in the tank of a rocket being readied for launch.

booster. **1.** Short for **booster engine** or **booster rocket.** **2.** =**launch vehicle.**

booster engine. An engine, especially a **booster rocket,** that adds its thrust to the thrust of the **sustainer engine.**

booster rocket. **1.** A **rocket motor,** either solid or liquid, that assists the normal propulsive system or **sustainer engine** of a rocket or aeronautical vehicle in some phase of its flight. **2.** A rocket used to set a vehicle in motion before another engine takes over.

boostglide vehicle. A **vehicle** designed to glide in the atmosphere following a rocket-powered phase. Portions of the flight may be **ballistic,** out of the atmosphere.

braking ellipses. A series of ellipses, decreasing in size due to **aerodynamic drag,** followed by a **spacecraft** in entering a planetary atmosphere.

breakoff phenomenon. The feeling which sometimes occurs during high-altitude flight of being totally separated and detached from the earth and human society. Also called the *breakaway phenomenon.*

bremsstrahlung (German, *braking radiation*). **Electromagnetic radiation** produced by the rapid change in the velocity of an electron or another fast, charged **particle** as it approaches an atomic **nucleus** and is deflected by it.

burnout. **1.** An act or instance of fuel or oxidant depletion or, ideally, the simultaneous depletion of both; the time at which this occurs. Compare **cutoff.** **2.** An act or instance of something burning out or of overheating; specifically, an act or instance of a rocket combustion chamber, nozzle, or other part overheating so as to result in damage or destruction.

capsule. **1.** A boxlike component or unit, often sealed. **2.** A small, sealed pressurized cabin with an internal **environment** which will support life in a man or animal during extremely high altitude flight, space flight, or emergency escape. See **ejection capsule.** **3.** A container carried on a rocket or spacecraft, as an instrument *capsule* holding instruments intended to be recovered after a flight.

cascade shower. A group occurrence of **cosmic rays.** Also called *air shower.*

cavitation. The formation of bubbles in a liquid, occurring whenever the **static pressure** at any point in the fluid flow becomes less than the fluid vapor pressure.

celestial mechanics. The study of the theory of the motions of **celestial bodies** under the influence of gravitational fields. See **gravitation.**

celestial sphere. An imaginary sphere of infinite radius concentric with the earth, on which all **celestial bodies** except the earth are assumed to be projected.

centrifuge. Specifically, a large motor-driven apparatus with a long arm at the end of which human and animal subjects

or equipment can be revolved and rotated at various speeds to simulate (very closely) the (prolonged) accelerations encountered in high-performance aircraft, rockets, and spacecraft. Sometimes called *astronautic centrifuge.*

chase pilot. A pilot who flies an escort airplane advising a pilot who is making a check, training, or research flight in another craft.

checkout. **1.** A sequence of actions taken to test or examine a thing as to its readiness for incorporation into a new phase of use, or for the performance of its intended function. **2.** The sequence of steps taken to familiarize a person with the operation of an airplane or other piece of equipment.

chemical fuel. **1.** A **fuel** that depends upon an **oxidizer** for combustion or for development of thrust, such as liquid or solid rocket fuel or internal-combusion-engine fuel; distinguished from **nuclear fuel.** **2.** A fuel that uses special chemicals, such as the fuel once projected for the afterburner of the B–70.

chemosphere. The vaguely defined region of the upper atmosphere in which **photochemical reactions** take place. It is generally considered to include the stratosphere (or the top thereof) and the mesosphere, and sometimes the lower part of the thermosphere.

chokes. Pain and irritation in the chest and throat as a result of reduced ambient pressure.

chuffing=chugging.

chugging. A form of **combustion instability** in a **rocket engine,** characterized by a pulsing operation at a fairly low frequency, sometimes defined as occurring between particular frequency limits; the noise made in this kind of combustion. Also called *chuffing.*

cislunar. [Latin ***cis,*** *on this side.*] Of or pertaining to phenomena, projects, or activity in the space between the earth and the moon's orbit. Compare **translunar.**

closed ecological system. A system that provides for the maintenance of life in an isolated living chamber through complete reutilization of the material available, in particular, by means of a cycle wherein exhaled carbon dioxide, urine, and other waste matter are converted chemically or by photosynthesis into oxygen, water, and food.

coherent. **1.** Of electromagnetic radiation, being **in phase,** so that waves at various points in space act in unison, as in a *laser producing coherent light.* **2.** Having a fixed relation between frequency and phase of input and output signal.

cold-flow test. A test of a **liquid rocket** without firing it to check or verify the efficiency of a propulsion subsystem, providing for the conditioning and flow of **propellants** (including tank pressurization, propellant loading, and propellant feeding).

comet. A luminous member of the **solar system** composed of a head, or **coma,** and often with a spectacular gaseous trail extending a great distance from the head.

command. A **signal** which initiates or triggers an action in the device which receives the signal. In computer operations also called *instruction.*

communications satellite. A **satellite** designed to reflect or relay electromagnetic signals used for communication.

companion body. A nose cone, last-stage rocket, or other body that orbits along with an earth **satellite.**

complex. **1.** Short for **launch complex,** as in *Complex 25B at Cape Kennedy.* **2.** Pertaining to a magnitude composed of a real number and an imaginary number.

composite materials. Structural materials of metals, **ceramics,** or plastics with built-in strengthening agents which may be in the form of filaments, foils, powders, or flakes of a different compatible material.

composite propellant. A **solid rocket propellant** consisting of a fuel and an oxidizer neither of which would burn without the presence of the other.

computer. **1.** A machine for carrying out calculations and performing specified transformations on information. Also called *computing machinery*. **2.** One who computes, or who operates a computer.

configuration. **1.** Relative position or disposition of various things, or the figure or pattern so formed. **2.** A geometric figure, usually consisting principally of points and connecting lines. **3.** =**planetary configuration.** **4.** A particular type of a specific aircraft, rocket, etc., which differs from others of the same model by virtue of the arrangement of its components or by the addition or omission of auxiliary equipment as *long-range configuration, cargo configuration.*

conic. **1.** A curve formed by the intersection of a plane and a right circular cone. Originally called *conic section.* **2.** In reference to satellite orbital parameters, without consideration of the perturbing effects of the actual shape or distribution of mass of the primary.

conic section. The original name for **conic.**

console. An array of controls and indicators for the monitoring and control of a particular sequence of actions, as in the checkout of a rocket, a countdown action, or a launch procedure.

contravane. A vane that reverses or neutralizes rotation of a **flow.** Also called a *countervane.*

control. **1.** A lever, switch, cable, knob, pushbutton, or other device or apparatus by means of which direction, regulation, or restraint is exercised over something. **2.** In plural **(a)** A system or assembly of levers, gears, wheels, cables, boosters, valves, etc., used to control the attitude, direction, movement, power, and speed of an aircraft, rocket, spacecraft, etc. **(b)** Control surfaces or devices. **3.** Sometimes capitalized. An activity or organization that directs or regulates an activity. **4.** Specifically, to direct the movements of an aircraft or rocket with particular references to changes in attitude and speed. Compare **guidance.**

control rocket. A **vernier engine, retrorocket**, or other such rocket, used to change the attitude of, guide, or make small changes in the speed of a rocket, spacecraft, or the like.

corona. **1.** The outer visible envelope of the sun. Also called *solar corona.* **2.** The extremely tenuous outer atmosphere of the sun now known to extend past the earth's orbit. **3.** A set of one or more prismatically colored rings of small radii, concentrically surrounding the disk of the sun, moon, or other luminary when veiled by a thin cloud. See **aurora.**

cosmic dust. Finely divided solid matter with particle sizes smaller than a **micrometeorite,** thus with diameters much smaller than a millimeter, moving in interplanetary space.

cosmic rays. The aggregate of extremely high-energy subatomic **particles** which travel the solar system and bombard the earth from all directions. Cosmic-ray primaries seem to be mostly protons, hydrogen nuclei, but also contain heavier nuclei. On colliding with atmospheric particles they produce many different kinds of lower energy **secondary cosmic radiation** (see **cascade shower**). Also called *cosmic radiation.*

COSPAR (*abbr*) = ***Co*mmittee on *Space* Research, International Council of Scientific Unions.**

countdown. **1.** A step-by-step process that culminates in a climactic event, each step being performed in accordance with a schedule marked by a count in inverse numerical order; specifically, this process is used in leading up to the launch of a large or complicated rocket vehicle, or in leading up to a captive test, a readiness firing, a mock firing, or other firing test. **2.** The act of counting inversely during this process.

cryogenic propellant. A rocket **fuel, oxidizer,** or propulsion fluid which is liquid only at very low temperatures.

cryogenic temperature. In general, a temperature range below the boiling point of nitrogen (−195° C); more particularly, temperatures within a few degrees of absolute zero.

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cutoff or **cut-off.** **1.** An act or instance of shutting something off; specifically, in rocketry, an act or instance of shutting off the **propellant** flow in a rocket, or of stopping the **combustion** of the propellant. Compare **burnout.** **2.** Something that shuts off, or is used to shut off. See **fuel shutoff.** **3.** Limiting or bounding as in *cutoff frequency.*

data reduction. Transformation of observed values into useful, ordered, or simplified information.

debug. **1.** To isolate and remove malfunctions from a device, or mistakes from a **routine** or **program.** **2.** Specifically, in electronic manufacturing, to operate equipment under specified environmental and test conditions in order to eliminate early failures and to stabilize equipment prior to actual use. Also called *burn-in.*

deceleration. The act or process of moving, or of causing to move, with decreasing speed. Sometimes called *negative acceleration.*

destruct. The deliberate action of destroying a rocket vehicle after it has been launched, but before it has completed its course.

digital computer. A **computer** which operates with information, numerical or otherwise, represented in a **digital** form.

diplexer. A device permitting an **antenna** system to be used simultaneously or separately by two transmitters. Compare **duplexer.**

dish. A **parabolic reflector** type of radio or radar **antenna.**

display. The graphic presentation of the **output** data of any device or system.

docking. The act of coupling two or more orbiting objects; the operation of mechanically connecting together, or in some manner bringing together, orbital payloads.

Doppler shift. **1.** =**Doppler effect.** **2.** The magnitude of the Doppler effect, measured in cycles per second.

dosimeter. 1. An instrument for measuring the **ultraviolet** in solar and sky radiation. Compare **actinometer.** 2. A device, worn by persons working around radioactive material, which indicates the *dose* of radiation to which they have been exposed.

Dovap (abbr) = ***Do*ppler, *v*elocity, *a*nd *p*osition.**

drogue parachute. 1. A type of parachute attached to a body, used to slow it down; also called *deceleration parachute* or *drag parachute.* 2. A parachute used specifically to pull something, usually a larger parachute, out of stowage, as *a drogue parachute deploys a drag parachute.*

duplexer. A device which permits a single **antenna** system to be used for both transmitting and receiving.

dynamic pressure (*symbol* q). The **pressure** of a fluid resulting from its motion, equal to one-half the fluid density times the fluid velocity squared ($1/2\rho V^2$). In incompressible flow, dynamic pressure is the difference between **total pressure** and **static pressure.** Also called *kinetic pressure.*

dysbarism. A condition of the body resulting from the existence of a pressure differential between the total **ambient** pressure and the total pressure of dissolved and free gases within the body tissues, fluids, and cavities.

ebullism. The formation of bubbles, with particular reference to water vapor bubbles in biological fluids caused by reduced ambient pressure; the boiling of body fluids.

eccentric. Not having the same center; varying from a circle.

ecliptic. The apparent annual path of the sun among the stars; the intersection of the plane of the earth's **orbit** with the **celestial sphere.**

ecological system. A habitable **environment,** either created artificially, as in a manned space vehicle, or occurring naturally, such as the environment on the surface of the earth, in which man, animals, or other organisms can live in mutual relationship with one another and the environment.

ejection capsule. **1.** In an aircraft or manned spacecraft, a detachable compartment serving as a cockpit or cabin, which may be ejected as a unit and parachuted to the ground. **2.** A satellite, probe, or unmanned spacecraft, a boxlike unit, usually containing recording instruments or records of observed data, which may be ejected and returned to earth by a parachute or other deceleration device.

elasticizer. An elastic substance or fuel used in a solid rocket propellant to prevent cracking of the propellant grain and to bind it to the combustion-chamber case.

electric propulsion. A general term encompassing all the various types of propulsion in which the **propellant** consists of charged electrical particles which are accelerated by electrical or magnetic fields, or both; for example, electrostatic propulsion, electromagnetic propulsion, electrothermal propulsion.

electromagnetic radiation. Energy propagated through space or through material media in the form of an advancing disturbance in electric and magnetic fields existing in space or in the media. The term *radiation*, alone, is used commonly for this type of energy, although it actually has a broader meaning. Also called *electromagnetic energy* or simply *radiation.*

electron. The **subatomic particle** that possesses the smallest possible negative electric charge (4.80298×10^{-10} electrostatic units).

electronic data processing. The use of **electronic** devices and systems in the processing of data so as to interpret the data and put them into usable form.

ellipse. A plane curve constituting the locus of all points the sum of whose distances from two fixed points called *focuses* or *foci* is constant; an elongated circle. See **conic section.**

environment. An external condition or the sum of such conditions, in which a piece of equipment, a living organism, or a system operates as in *temperature environment*, *vibration environment*, or *space environment.*

epoch. A particular instant for which certain data are valid, as the data for which an astronomical catalogue is computed.

escape velocity. The **radial speed** which a particle or larger body must attain in order to escape from the gravitational field of a planet or star. When friction is neglected, the escape velocity is

$$\sqrt{2Gm/r}$$

where G is the universal gravitational constant (see **gravitation**); m is the mass of the planet or star; and r is the radial distance from the center of the planet or star. Also called *escape speed.*

exobiology. That field of biology which deals with the effects of extraterrestrial environments on living organisms and with the search for extraterrestrial life.

exosphere. The outermost, or topmost, portion of the **atmosphere.** Its lower boundary is the **critical level of escape,** variously estimated at 500 to 1000 kilometers above the earth's surface. Also called *region of escape.*

exotic fuel. Any fuel considered to be unusual, as a boron-base fuel.

explosive bolt. A bolt incorporating an explosive which can be detonated on command, thus destroying the bolt. Explosive bolts are used, for example, in separating a **satellite** from a **rocket.**

eyeballs in, eyeballs out, eyeballs down, eyeballs up, eyeballs left, eyeballs right. See physiological acceleration.

fallaway section. A section of a **rocket** vehicle that is cast off and separates from the vehicle during flight, especially such a section that falls back to the earth.

fatigue. A weakening or deterioration of metal or other material occurring under load, especially under repeated cyclic, or continued loading.

field. A region of space within which each point has a definite value of a given physical or mathematical quantity.

film cooling. The cooling of a body or surface, such as the inner surface of a rocket **combustion chamber,** by maintaining a thin fluid layer over the affected area.

fixed satellite. A **satellite** that orbits the earth from west to east at such a speed as to remain fixed over a given place on the earth's equator at approximately 35,900 kilometers altitude. See **stationary orbit, synchronous satellite**

flare. **1.** A bright eruption from the sun's chromosphere. Compare **prominence.** **2.** Pyrotechnic devices used for signalling or to provide illumination. **3.** An expansion at the end of a cylindrical body as at the base of a rocket.

flashback. A reversal of flame in a system, counter to the usual flow of the combustible mixture.

flux. **1.** The rate of **flow** of some quantity, often used in reference to the flow of some form of **energy.** Also called *transport.* **2.** In nuclear physics generally, the number of **radioactive particles** per unit volume times their mean velocity.

flying test bed. An aircraft, rocket, or other flying **vehicle** used to carry objects or devices being flight tested.

free fall. **1.** The fall or drop of a body, such as a rocket, not guided, not under thrust, and not retarded by a parachute or other braking device. **2.** The free and unhampered motion of a body along a Keplerian **trajectory,** in which the force of **gravity** is counterbalanced by the force of **inertia.** See **weightlessness.**

g or **G.** An acceleration equal to the **acceleration of gravity,** 980.665 centimeter-second-squared, approximately 32.2 feet per second per second at sea level; used as a unit of stress measurement for bodies undergoing acceleration. See **gravity.**

gamma ray. A quantum of **electromagnetic radiation** emitted by a **nucleus,** each such photon being emitted as the result of a quantum transition between two energy levels of the nucleus. Gamma rays have energies usually between 10 thousand electron volts and 10 million electron volts with correspondingly short wavelengths and high frequencies. Also called *gamma radiation.*

gantry. A frame structure that spans over something, as an elevated platform that runs astride a work area, supported by wheels on each side; short for *gantry crane* or *gantry scaffold.*

gantry scaffold. A massive scaffolding structure mounted on a bridge or platform supported by a pair of towers or trestles that normally run back and forth on parallel tracks, used to assemble and service a large **rocket** as the rocket rests on its launching pad. Often shortened to *gantry.*

garbage. Miscellaneous objects in **orbit,** usually material ejected or broken away from a **launch vehicle** or **satellite.**

gas cap. The gas immediately in front of a body as it travels through the atmosphere.

generation. In any technical or technological development, as of a missile, jet engine, or the like, a stage or period that is marked by features or performances not marked, or existent, in a previous period of development or production, as in *the first generation of rockets using liquid propellants.*

geo. A prefix meaning earth, as in *geology, geophysics.*

geocentric. Relative to the earth as a center; measured from the center of the earth.

geodetic. Of or pertaining to **geodesy;** geodesic.

geomagnetism. **1.** The **magnetic** phenomena, collectively considered, exhibited by the earth and its atmosphere and by extension the magnetic phenomena in interplanetary **space.** **2.** The study of the **magnetic field** of the earth. Also called *terrestrial magnetism.*

geophysics. The physics of the earth and its environment, i.e., earth, air, and (by extension) space.

geopotential. The **potential energy** of a unit mass relative to sea level, numerically equal to the work that would be done in lifting the unit mass from sea level to the height at which the mass is located; commonly expressed in terms of **dynamic height** or **geopotential height.**

giga (*abbr* **G**). A prefix meaning multiplied by 10^9.

gimbal. **1.** A device with two mutually perpendicular and intersecting **axes of rotation,** thus giving free angular movement in two directions, on which an engine or other object may be mounted. **2.** In a **gyro,** a support which provides the **spin axis** with a **degree of freedom.** **3.** To move a **reaction engine** about on a gimbal so as to obtain pitching and yawing **correction moments.** **4.** To mount something on a gimbal.

gnotobiotics. The study of germ-free animals.

gox. Gaseous oxygen.

grain. **1.** An elongated molding or extrusion of **solid propellant** for a **rocket,** regardless of size. **2.** In photography, a small particle of metallic silver remaining in a photographic emulsion after development and fixing. In the agglomerate, these grains form the dark area of a photographic image. **3.** An individual crystal in a polycrystalline metal or alloy.

gravitation. The **acceleration** produced by the mutual attraction of two masses, directed along the line joining their centers of masses, and of magnitude inversely proportional to the square of the distance between the two centers of mass.

gravity. Viewed from a frame of reference fixed in the earth, force imparted by the earth to a mass which is at rest relative to the earth. Since the earth is rotating, the force observed as gravity is the resultant of the force of **gravitation** and the **centrifugal force** arising from this rotation and the use of an earthbound rotating frame of reference. It is directed normal to sea level and to its geopotential surfaces.

g-suit or **G-suit.** A suit the exerts pressure on the abdomen and lower parts of the body to prevent or retard the collec-

tion of blood below the chest under positive **acceleration.** Compare **pressure suit.**

g-tolerance. A tolerance in a person or other animal, or in a piece of equipment, to an **acceleration** of a particular value.

guidance. The process of directing the movements of an aeronautical vehicle or space vehicle, with particular reference to the selection of a flight path. See **control.**

gyro. A device which utilizes the angular momentum of a spinning mass (rotor) to sense angular motion of its base about one or two axes orthogonal to the spin axis. Also called *gyroscope.*

hardness. Resistance of metal to plastic deformation usually by indentation. However, the term may also refer to stiffness or temper, or to resistance to scratching, abrasion, or cutting.

heat exchanger. A device for transferring heat from one fluid to another without intermixing the fluids, as **(a) a regenerator,** and **(b)** an apparatus for cooling or heating the air in a wind tunnel. See **radiator,** sense **2.**

heat shield. **1.** Any device that protects something from heat. **2.** Specifically, the protective structure necessary to protect a **reentry** body from **aerodynamic heating.** See **heat sink.**

heat sink. **1.** In thermodynamic theory, a means by which **heat** is stored, or is dissipated or transferred from the **system** under consideration. **2.** A place toward which the heat moves in a system. **3.** A material capable of absorbing heat; a device utilizing such a material and used as a thermal protection device on a **spacecraft** or **reentry** vehicle. **4.** In nuclear propulsion, any thermodynamic device, such as a **radiator** or **condenser,** that is designed to absorb the excess heat energy of the **working fluid.** Also called *heat dump.*

hold. **1.** During a **countdown** to stop counting and to wait until an impediment has been removed so that the countdown can be resumed, as in *T minus 40 and holding.* **2.** In com-

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puter terminology, to retain information in one **storage** device after copying it into another storage device.

hot test. A propulsion system test conducted by actually firing the **propellants.** Compare **cold-flow test.**

human engineering. The activity or science of designing, building, or equipping mechanical devices or artificial environments to the anthropometric, physiological, or psychological requirements of the men who will use them.

hunting. *Fluctuation about a midpoint due to* **instability,** as **oscillations** of the needle of an instrument about the zero point, or alternate lead and lag of a synchronous motor with respect to the alternating current.

hypersonic. **1.** Pertaining to **hypersonic flow.** **2.** Pertaining to speeds of Mach 5 or greater.

hypersonic flow. In aerodynamics, **flow** of a fluid over a body at speeds much greater than the speed of sound and in which the shock waves start at a finite distance from the surface of the body.

hypoxia. Oxygen want or deficiency; any state wherein a physiologically inadequate amount of oxygen is available to, or utilized by, tissue without respect to cause or degree. Compare **anoxia.**

igniter. A device used to begin combustion, such as a spark plug in the combustion chamber of a jet engine, or a squib used to ignite the fuel in a rocket.

impact area. The area in which a rocket strikes the surface of the earth or other celestial body.

inertial guidance. **Guidance** by means of the measurement and integration of **acceleration** from within the craft.

infrared radiation (*abbr* **IR**). **Electromagnetic radiation** lying in the wavelength interval from about 75 microns to an indefinite upper boundary sometimes arbitrarily set at 1,000 microns (0.01 centimeter). Also called *long-wave radiation.*

injection. **1.** The introduction of fuel, fuel and air, fuel and oxidizer, water, or other substance into an engine induction system or **combustion chamber.** **2.** The time following launching when nongravitational forces (thrust, lift, and drag) become negligible in their effect on the **trajectory** of a rocket or spacecraft. **3.** The process of putting a spacecraft up to **escape velocity.**

interferometer. An apparatus used to produce and measure **interference** from two or more **coherent** wave trains from the same source.

ion. **1.** A charged **atom** or molecularly bound group of atoms; sometimes also a free **electron** or other charged **subatomic particle.** **2.** In atmospheric electricity, any of several types of electrically charged submicroscopic particles normally found in the atmosphere. Atmospheric ions are of two principal types, **small ions** and **large ions,** although a class of **intermediate ions** has occasionally been reported. **3.** In chemistry, **atoms** or specific groupings of atoms which have gained or lost one or more electrons, as the *chloride ion* or *ammonium ion.* Such ions exist in aqueous solutions and in certain crystal structures.

ionosphere. The **atmospheric shell** characterized by a high **ion** density. Its base is at about 70 or 80 kilometers and it extends to an indefinite height.

isotropic. In general, pertaining to a state in which a quantity or spatial derivatives thereof are independent of direction. Also called *isotropous.*

jerk. A **vector** that specifies the time rate of change of the **acceleration;** the third derivative of displacement with respect to time.

Kepler laws. The three empirical laws governing the motions of planets in their **orbits,** discovered by Johannes Kepler (1571–1630). These are: **(a)** the orbits of the planets are **ellipses,** with the sun at a common focus; **(b)** as a planet moves in its orbit, the line joining the planet and sun sweeps over equal areas in equal intervals of time (also called

law of equal areas); **(c)** the squares of the periods of revolution of any two planets are proportional to the cubes of their mean distances from the sun.

laser. (From *l*ight *a*mplification by *s*timulated *e*mission of *r*adiation.) A device for producing light by **emission** of **energy** stored in a molecular or atomic system when stimulated by an input **signal.**

launch pad. The load-bearing base or platform from which a **rocket vehicle** is launched. Usually called *pad.*

launch vehicle. A **rocket** or other vehicle used to launch a **probe, satellite,** or the like.

launch window. The postulated opening in the continuum of time or of space, through which a **spacecraft** or missile must be launched in order to achieve a desired encounter, rendezvous, impact, or the like.

libration. A real or apparent oscillatory motion, particularly the apparent **oscillation** of the moon.

lift-off. The action of a **rocket vehicle** as it separates from its **launch pad** in a vertical ascent.

line of position. In navigation, a line representing all possible locations of a craft at a given instant.

liquid-propellant rocket engine. A rocket engine using a **propellant** or propellants in **liquid** form. Also called *liquid-propellant rocket.*

longitudinal axis. The fore-and-aft line through the **center of gravity** of a craft.

lox. 1. Liquid oxygen. Used attributively as in *lox tank, lox unit.* Also called *loxygen.* **2.** To load the fuel tanks of a rocket vehicle with liquid oxygen. Hence, loxing.

Mach number (*symbols* M, N_{Ma}). (Pronounced *mock,* after Ernest Mach, 1838–1916, Austrian scientist.) A number expressing the ratio of the speed of a body or of a point on a body with respect to the surrounding air or other **fluid,** or

the speed of a **flow,** to the **speed of sound** in the medium; the speed represented by this number.

magnetic storm. A worldwide disturbance of the earth's **magnetic field.**

magnetohydrodynamics (*abbr* **MHD**). The study of the interaction that exists between a **magnetic field** and an electrically conducting **fluid.** Also called *magnetoplasmadynamics, magnetogasdynamics, hydromagnetics.*

magnetometer. An instrument used in the study of **geomagnetism** for measuring a **magnetic element.**

magnitude (*symbol* ***m***). **1.** The relative **luminance** of a celestial body. The smaller (algebraically) the number indicating magnitude, the more luminous the body. Also called *stellar magnitude.*

main bang. The transmitted **pulse,** within a **radar** system.

main stage. **1.** In a multistage rocket, the **stage** that develops the greatest amount of **thrust,** with or without **booster engines.** **2.** In a **single-stage rocket** vehicle powered by one or more engines, the period when full thrust (at or above 90 percent) is attained. **3.** A **sustainer engine,** considered as a stage after booster engines have fallen away, as in *the main stage of the Atlas.*

manometer. An instrument for measuring pressure of gases and vapors both above and below **atmospheric pressure.**

maser. An **amplifier** utilizing the principle of *m*icrowave *a*mplification by *s*timulated *e*mission of *r*adiation. ***Emission*** of energy stored in a molecular or atomic system by a **microwave** power supply is stimulated by the **input signal.**

mass (*symbol* ***m***). A quantity characteristic of a body, which relates the attraction of this body toward another body. Since the mass of a body is not fixed in magnitude, all masses are referred to the standard kilogram, which is a lump of platinum.

mass-energy equivalence. The equivalence of a quantity of **mass** m and a quantity of **energy** E, the two quantities being related by the mass-energy relation, $E=mc^2$.

mass ratio. The ratio of the mass of the **propellant** charge of a **rocket** to the total mass of the rocket when charged with the propellant.

mate. To fit together two major **components** of a **system.** Also called *marry*.

mean free path (*symbol* l, λ, L). **1.** Of any **particle,** the average distance that a particle travels between successive collisions with the other particles of an ensemble. **2.** Specifically, the average distance traveled by the **molecules** of a **perfect gas** between consecutive collisions with one another. It may be determined roughly from either of the formulas

$$l=3\mu/\rho c=3\nu/c$$

or

$$l=1/\sqrt{2\pi\ \overline{nd^2}}$$

where l is the mean free path; μ is the dynamic viscosity; ν is the kinematic viscosity; ρ is the density; c is the molecular speed (a function of the gas temperature); n is the number of molecules per unit volume; and d is the molecule diameter. **3.** For any process the reciprocal of the **cross section** per unit volume for that process.

mechanoreceptor. A nerve ending that reacts to mechanical stimuli, as touch, tension, and acceleration.

mega (*abbr* **M**). A prefix meaning multiplied by 10^6.

memory. The component of a **computer,** control system, guidance system, instrumented satellite, or the like, designed to provide ready access to data or instructions previously recorded so as to make them bear upon an immediate problem, such as the guidance of a physical object, or the analysis and reduction of data.

meteor. In particular, the light phenomenon which results from the entry into the earth's atmosphere of a solid particle

from space; more generally, any physical object or phenomenon associated with such an event. See **meteoroid.**

meteoric. Of or pertaining to **meteors** and **meteoroids.**

meteorite. Any **meteoroid** which has reached the surface of the earth without being completely vaporized.

meteoroid. A solid object moving in interplanetary space, of a size considerably smaller than an **asteroid** and considerably larger than an atom or molecule.

meteorological rocket. A **rocket** designed primarily for routine **upper air observation** (as opposed to research) in the lower 250,000 feet of the atmosphere, especially that portion inaccessible to balloons, i.e., above 100,000 feet. Also called *rocketsonde.*

micro (*abbr*). **1.** (*abbr* μ). A prefix meaning divided by 10^6. **2.** A prefix meaning very small, as in micrometeorite.

micrometeorite. A very small **meteorite** or meteoritic particle with a diameter in general less than a millimeter.

microwave region. Commonly, that region of the radio spectrum between approximately 1000 megacycles and 300,000 megacycles.

miniaturize. To construct a functioning miniature of a part or instrument. Said of telemetering instruments or parts used in an earth satellite or rocket vehicle, where space is at a premium. Hence, *miniaturized, miniaturization.*

minitrack. A satellite tracking system consisting of a field of separate antennas and associated receiving equipment interconnected so as to form interferometers which track a transmitting beacon in the payload itself.

missile. Any object thrown, dropped, fired, launched, or otherwise projected with the purpose of striking a target. Short for *ballistic missile, guided missile.*

mockup. A full-sized replica or dummy of something, such as a spacecraft, often made of some substitute material such as

wood, and sometimes incorporating actual functioning pieces of equipment, such as engines.

modulation. **1.** The variation in the value of some parameter characterizing a periodic **oscillation.** **2.** Specifically, variation of some characteristic of a **radio wave,** called the *carrier wave,* in accordance with instantaneous values of another wave, called the *modulating wave.*

module. **1.** A self-contained unit of a **launch vehicle** or **spacecraft** which serves as a building block for the overall structure. The module is usually designated by its primary function as *command module, lunar landing module,* etc. **2.** A one-package assembly of functionally associated electronic parts, usually a plug-in unit, so arranged as to function as a **system** or **subsystem; a black box.** **3.** The size of some one part of a **rocket** or other structure, as the semidiameter of a rocket's base, taken as a unit of measure for the proportional design and construction of component parts.

molecule. An aggregate of two or more **atoms** of a substance that exists as a unit.

monopropellant. A **rocket propellant** consisting of a single substance, especially a liquid, capable of producing a heated jet without the addition of a second substance.

multiplexer. A mechanical or electrical device for time sharing of a **circuit.**

multiplexing. The simultaneous transmission of two or more **signals** within a single **channel.**

multipropellant. A **rocket propellant** consisting of two or more substances fed separately to the **combustion chamber.** See **bipropellant.**

multistage rocket. A vehicle having two or more **rocket** units, each unit firing after the one in back of it has exhausted its **propellant.** Normally, each unit, or stage, is jettisoned after completing its firing. Also called a *multiple-stage rocket* or, infrequently, a *step rocket.*

nana (*abbr* **n**). A prefix meaning multiplied by 10^{-9}.

neutron. A **subatomic particle** with no electric charge, and with a mass of 1.67482×10^{-24} gram.

Newton laws of motion. A set of three fundamental postulates forming the basis of the mechanics of rigid bodies, formulated by Newton in 1687.

noise. **1.** Any undesired **sound.** By extension, noise is any unwanted disturbance within a useful frequency band, such as undesired electric waves in a transmission channel or device. **2.** An erratic, intermittent, or statistically random **oscillation.** **3.** In electrical circuit analysis, that portion of the unwanted **signal** which is statistically random, as distinguished from hum, which is an unwanted signal occurring at multiples of the power-supply frequency.

normal shock wave. A **shock wave** perpendicular, or substantially so, to the direction of flow in a **supersonic flow** field. Sometimes shortened to *normal shock.*

nose cone. The cone-shaped leading end of a **rocket vehicle,** consisting **(a)** of a chamber or chambers in which a satellite, instruments, animals, plants, or auxiliary equipment may be carried, and **(b)** of an outer surface built to withstand high temperatures generated by **aerodynamic heating.**

nova (*plural* **novae**). A star which suddenly becomes many times brighter than previously, and then gradually fades.

nozzle (*symbol* ***n*** used as subscript). **1.** A duct, tube, pipe, spout, or the like through which a **fluid** is directed and from the open end of which the fluid is discharged, designed to meter the fluid or to produce a desired direction, velocity, or shape of discharge. **2.** Specifically, that part of a **rocket thrust chamber** assembly in which the gases produced in the chamber are accelerated to high velocities.

nuclear fuel. **Fissionable** material of reasonable long life, used or usable in producing energy in a **nuclear reactor.**

nuclear radiation. Corpuscular emissions, such as **alpha** and **beta particles,** or **electromagnetic radiation,** such as **gamma rays,** originating in the nucleus of an atom.

nuclear reactor. An apparatus in which nuclear **fission** may be sustained in a self-supporting **chain reaction.** Commonly called *reactor.* Formerly called *pile.*

nucleus. **1.** The positively charged core of an **atom** with which is associated practically the whole mass of the atom but only a minute part of its volume. **2.** In biology, a definitely delineated body within a cell containing the chromosomes.

occultation. The disappearance of a body behind another body of larger apparent size.

octave. The interval between any two **frequencies** having the ratio of 1 : 2.

oculogravic illusion = agravic illusion.

oculogyral illusion. The apparent movement of an image in space in the same direction as that in which one seems to be turning when the **semicircular canals** are stimulated.

orbit. **1.** The path of a body or particle under the influence of a **gravitational** or other force. For instance, the orbit of a **celestial body** is its path relative to another body around which it revolves. **2.** To go around the earth or other body in an orbit, sense **1.**

orbital elements. A set of seven parameters defining the **orbit** of a body attracted by a central, inverse-square force.

orbital period. The interval between successive passages of a **satellite** through the same point in its **orbit.** Often called *period.* See **anomalistic period.**

orbital velocity. **1.** The average velocity at which an earth **satellite** or other orbiting body travels around its **primary.** **2.** The velocity of such a body at any given point in its orbit, as in *its orbital velocity at the apogee is less than at the perigee.* **3. = circular velocity.**

order of magnitude. A factor of 10.

otolith. A small calcareous concretion located in the inner ear which plays a part in the mechanism of orientation.

outgassing. The evolution of gas from a material in a **vacuum.**

oxidizer (*symbol* ***o,*** used as subscript). Specifically, a substance (not necessarily containing oxygen) that supports the combustion of a **fuel** or **propellant.**

pad=launch pad.

passive. Containing no power sources to augment output power, e.g., *passive electrical network, passive reflector* (as in the Echo satellite). Applied to a device that draws all its power from the **input signal.**

payload. **1.** Originally, the revenue-producing portion of an aircraft's load; e.g., passengers, cargo, mail, etc. **2.** By extension, that which an aircraft, rocket, or the like carries over and above what is necessary for the operation of the vehicle for its flight.

peri. A prefix meaning *near* as in *perigee.*

perigee. That orbital point nearest the earth when the earth is the center of attraction. See **orbit.**

perturbation. **1.** Any departure introduced into an assumed **steady state** of a system, or a small departure from a nominal path such as a desired trajectory. Usually used as equivalent to **small perturbation.** **2.** Specifically, a disturbance in the regular motion of a **celestial body,** the result of a force additional to that which causes the regular motion, specifically, a gravitational force.

photon. According to the **quantum theory** of **radiation,** the elementary quantity, or quantum, of radiant energy. It is regarded as a discrete quantity having a momentum equal to $h\nu/c$, where h is Planck constant, ν is the frequency of the radiation, and c is the speed of light in a vacuum. The photon is never at rest, has no electric charge and no magnetic

moment, but does have a spin moment. The energy of a photon (the unit quantum of energy) is equal to $h\nu$.

photon engine. A projected type of **reaction engine** in which thrust would be obtained from a stream of **electromagnetic radiation.**

photosphere. The intensely bright portion of the sun visible to the unaided eye.

physiological acceleration. The **acceleration** experienced by a human or an animal test subject in an accelerating vehicle.

pickoff. A sensing device that responds to angular movement to create a signal or to effect some type of control, as *a pickoff on a gyro in an automatic pilot.*

pickup. **1.** A device that converts a sound, scene, or other form of intelligence into corresponding electric **signals** (e.g., a microphone, a television camera, or a phonograph pickup). **2.** The minimum current, voltage, power, or other value at which a **relay** will complete its intended function. **3. Interference** from a nearby circuit or electrical system.

pico. A prefix meaning multiplied by 10^{-12}.

pip. Signal indication on the **oscilloscope** screen of an electronic instrument, produced by a short, sharply peaked pulse of voltage. Also called *blip.*

pitchover. **1.** The programed turn from the **vertical** that a **rocket** takes as it describes an arc and points in a direction other than vertical. **2.** The point-in-space of this action.

plages. Clouds of calcium or hydrogen vapor that show up as bright patches on the surface of the **photosphere** of the sun.

planet. A **celestial body** of the **solar system,** revolving around the sun in a nearly circular orbit, or a similar body revolving around a star.

plasma. An electrically conductive gas comprised of neutral particles, **ionized** particles, and **free electrons** but which, taken as a whole, is electrically neutral.

plasma engine. A **reaction engine** using magnetically accelerated **plasma as propellant.**

plasma sheath. **1.** The boundary layer of charged particles between a **plasma** and its surrounding walls, electrodes, or other plasmas. **2.** An envelope of **ionized gas** that surrounds a body moving through an atmosphere at **hypersonic velocities.**

polarization. **1.** The state of **electromagnetic radiation** when transverse vibrations take place in some regular manner; e.g., all in one plane, in a circle, in an ellipse, or in some other definite curve. **2.** With respect to particles in an **electric field,** the displacement of the charge centers within a particle in response to the electric force acting thereon. **3.** The response of the molecules of a **paramagnetic** medium (such as iron) when subjected to a **magnetic field.**

posigrade rocket. An auxiliary **rocket** which fires in the direction in which the **vehicle** is pointed, used, for example, in separating two stages of a vehicle.

precession. Change in the direction of the axis of rotation of a spinning body, as a gyro, when acted upon by a **torque.** See **precession of the equinoxes.**

precession of the equinoxes. The conical motion of the earth's **axis** about the normal to the plane of the **ecliptic,** caused by the attractive force of the sun, moon, and other planets on the equatorial protuberance of the earth.

pressure suit. A garment designed to provide pressure upon the body so that respiratory and circulatory functions may continue normally, or nearly so, under low-pressure conditions, such as occur at high altitudes or in space without benefit of a **pressurized cabin.**

pressurized. Containing air, or other gas, at a **pressure** higher than **ambient.**

prestage. **1.** A step in the action of igniting a large liquid rocket taken prior to the ignition of the full flow, and consisting of igniting a partial flow of **propellants** into the **thrust chamber.** **2.** The partial flow thus ignited. Also called *preliminary stage.*

primary. **1.** Short for **primary body.** **2.** Short for **primary cosmic ray.**

primary body. The **celestial body** or **central force field** about which a **satellite** or other body orbits, or from which it is escaping, or towards which it is falling.

primary cosmic rays. High-enery **particles** originating outside the earth's **atmosphere.**

probability. The chance that a prescribed event will occur, represented as a pure number P in the range $0 \leq P \leq 1$. The probability of an impossible event is zero and that of an inevitable event is unity.

probe. **1.** Any device inserted in an **environment** for the purpose of obtaining information about the environment. **2.** In geophysics, a device used to make a **sounding.** **3.** Specifically, an instrumented vehicle moving through the **upper atmosphere** or **space** or landing upon another celestial body in order to obtain information about the specific environment. **4.** Specifically, a slender device or apparatus projected into a moving **fluid,** as for measurement purposes; a **pitot tube.** **5.** Specifically, a slender projecting pipe on an aircraft which is thrust into a **drogue** to receive fuel in inflight refueling.

prominence. A filamentlike protuberance from the **chromosphere** of the sun. Compare **flare.**

propellant (*symbol* p, used as a subscript). Any agent used for consumption or combustion in a **rocket** and from which the rocket derives its thrust, such as a **fuel, oxidizer,** additive, catalyst, or any compound or mixture of these; specifically, a fuel, oxidant, or a combination or mixture of fuel and oxidant used in propelling a rocket.

proton. A positively charged **subatomic particle** having a mass of 1.67252×10^{-24} gram, slightly less than of a neutron but about 1836 times greater than that of an electron.

proving stand. A test stand for **reaction engines,** especially rocket engines.

purge. To rid a line or tank of residual fluid, especially of fuel or oxygen in the tanks or lines of a **rocket** after a test firing or simulated test firing.

***q*=dynamic pressure,** as *the vehicle encountered maximum q 40 seconds after lift-off.*

quantization. The process of converting from continuous values of information to a finite number of **discrete values.**

quantum theory. The theory first stated by Max Planck (before the Physical Society of Berlin on December 14, 1900) that all **electromagnetic radiation** is emitted and absorbed in *quanta,* each of magnitude $h\nu$, h being the **Planck constant** and ν the **frequency** of the radiation.

radar astronomy. The study of celestial bodies within the solar system by means of **radiation** originating on earth but reflected from the body under observation. See **radio astronomy.**

radiation. **1.** The process by which electromagnetic energy is propagated through free space by virtue of joint undulatory variations in the electric and magnetic fields in space. This concept is to be distinguished from conduction and convection. **2.** The process by which energy is propagated through any medium by virtue of the **wave motion** of that medium, as in the propagation of sound waves through the atmosphere, or ocean waves along the water surface. **3.** =**radiant energy.** **4.** =**electromagnetic radiation,** specifically, high-energy radiation such as **gamma rays** and **X-rays.** **5.** Corpuscular emissions, such as α- or β-radiation. **6.** =**nuclear radiation.** **7.** =**radioactivity.**

radiation pressure (*symbol* P_r). **Pressure** exerted upon any material body by **electromagnetic radiation** incident upon it.

radiation shield. **1.** A device used on certain types of instruments to prevent unwanted **radiation** from biasing the measurement of a quantity. **2.** A device used to protect human beings from the harmful effects of **nuclear radiation,** cosmic radiation, or the like. **3.** =**heat shield.**

radiator. **1.** Any source of **radiant energy,** especially **electromagnetic radiation.** **2.** A device that dissipates the heat from something, as from water or oil, not necessarily by radiation only.

radio astronomy. **1.** The study of **celestial** objects through observation of **radiofrequency** waves emitted or reflected by these objects. **2.** Specifically, the study of celestial objects by measurement of the radiation emitted by them in the radiofrequency range of the electromagnetic spectrum.

radio meteor. A **meteor** which has been detected by the reflection of a radio **signal** from the meteor trail of relatively high ion density **(ion column).**

radiosonde. An instrument, usually balloon-borne, for the simultaneous measurement and transmission of meteorological data while moving vertically through the atmosphere.

radio telescope. A device for receiving, amplifying, and measuring the intensity of **radio waves** originating outside the earth's atmosphere or reflected from a body outside the atmosphere.

rarefied gas dynamics. The study of the phenomena related to the molecular or noncontinuum nature of gas **flow** at densities where

$$\lambda/l > 0.01$$

when λ is molecular mean free path and l is a characteristic dimension of the flow field.

reaction engine. An engine that develops **thrust** by its reaction to a substance ejected from it; specifically, such an engine that ejects a **jet** or stream of gases created by the burning of fuel within the engine. Also called **reaction motor.**

readout. 1. The action of a radio **transmitter** transmitting data either instantaneously with the acquisition of the data or by playing of a magnetic tape upon which the data have been recorded. 2. The data transmitted by the action described in sense 1. 3. In **computer** operations, to extract information from **storage.**

readout station. A recording or receiving radio station at which data are received from a **transmitter** in a probe, satellite, or other **spacecraft.**

real time. Time in which reporting on events or recording of events is simultaneous with the events.

recombination. The process by which a positive and a negative **ion** join to form a neutral **molecule** or other neutral particle, also process by which radicals or dissociations species join to form molecules.

recovery. 1. The procedure or action that obtains when the whole of a **satellite,** or a section, instrumentation package, or other part of a rocket vehicle is retrieved after a launch, as in *recovery was counted upon to give added data.* 2. The conversion of **kinetic energy** to **potential energy** such as in the deceleration of air in the duct of a **ramjet engine.** Also called *ram recovery.* 3. In flying, the action of a lifting vehicle returning to an equilibrium attitude after a non-equilibrium maneuver.

recycle. 1. In a **countdown** to stop the count and to return to an earlier point in the countdown, as in *we have recycled, now at T minus 80 and counting.* Compare **hold.** 2. To give a completely new **checkout** to a rocket or other object.

red shift. In astronomy, the displacement of observed spectral lines toward the longer wavelengths of the red end of the spectrum. Compare **space reddening.**

reentry. The event occurring when a **spacecraft** or other object comes back into the **sensible atmosphere** after being rocketed to higher altitudes; the action involved in this event.

reentry vehicle. Any payload carrying **vehicle** designed to leave the **sensible atmosphere** and then return through it to earth.

regenerative cooling. The cooling of a part of an engine by the fuel or propellant being delivered to the combustion chamber; specifically, the cooling of a rocket-engine **combustion chamber** or **nozzle** by circulating the **fuel** or **oxidizer,** or both, around the part to be cooled.

regenerator. A device used in a **thermodynamic** process for capturing and returning to the process **heat** that would otherwise be lost. Also called a *heat exchanger.*

relativistic. In general, pertaining to material, as a particle, moving at speeds which are an appreciable fraction of the **speed of light** thus increasing the mass.

relativity. A principle that postulates the equivalence of the description of the universe, in terms of physical laws, by various observers, or for various frames of reference.

rendezvous. **1.** The event of two or more objects meeting with zero **relative** velocity at a preconceived time and place. **2.** The point in **space** at which such an event takes place, or is to take place.

retrorocket. (From *retro*acting.) A **rocket** fitted on or in a spacecraft, satellite, or the like to produce **thrust** opposed to forward motion.

revolution. **1.** Motion of a **celestial body** in its orbit; circular motion about an **axis** usually external to the body. **2.** One complete cycle of the movement of a **celestial body** in its orbit, or of a body about an external axis, as *a revolution of the earth about the sun.*

rocket. **1.** A projectile, pyrotechnic device, or flying **vehicle** propelled by a **rocket engine.** **2.** A **rocket engine;** any one of the *combustion chambers* or tubes of a multichambered **rocket engine.**

rocket engine. A **reaction engine** that contains within itself, or carries along with itself, all the substances necessary

for its operation or for the consumption or combustion of its **fuel,** not requiring intake of any outside substance and hence capable of operation in outer space. Also called *rocket motor.*

rocket propellant (*abbr* **RP**). **1.** Any agent used for consumption or combustion in a rocket and from which the rocket derives its thrust, such as a **fuel,** oxidizer, additive, catalyst, or any compound or mixture of these. **2.** The ejected **fluid** in a nuclear rocket.

rocketsonde=**meteorological rocket.**

rockoon. A high-altitude **sounding** system consisting of a small **solid-propellant** research **rocket** carried aloft by a large plastic balloon.

roll. **1.** The act of rolling; rotational or oscillatory movement of an aircraft or similar body about a **longitudinal axis** through the body—called *roll* for any degree of such rotation. **2.** The amount of this movement; i.e., the angle of roll.

rotation. **1.** Turning of a body about an axis within the body, as *the daily rotation of the earth.* See **revolution.** **2.** One turn of a body about an internal axis, as *a rotation of the earth.*

rumble. A form of **combustion instability,** especially in a **liquid-propellant rocket engine,** characterized by a low-pitched, low-frequency rumbling noise; the noise made in this kind of combustion.

satellite. **1.** An attendant body that revolves about another body, the **primary;** especially in the solar system, a secondary body, or moon, that revolves about a planet. **2.** A manmade object that revolves about a spatial body, such as Explorer I orbiting about the earth. **3.** Such a body intended and designed for orbiting, as distinguished from a companion body that may incidentally also orbit, as in *the observer actually saw the orbiting rocket rather than the satellite.* **4.** An object not yet placed in orbit, but designed or expected to be launched into an orbit.

scale height (*symbol* h, h_s). A measure of the relationship between density and temperature at any point in an **atmosphere**; the thickness of a **homogeneous atmosphere** which would give the observed temperature:

$$h=kT/mg=R^*T/Mg$$

where k is the **Boltzmann constant**; T is the absolute temperature; m and M are the mean molecular mass and weight, respectively, of the layer; g is the acceleration of gravity; and R^* is the universal gas constant.

schlieren. (German, *streaks, striae.*) **1.** Regions of different density in a **fluid,** especially as shown by special apparatus. **2.** Pertaining to a method or apparatus for visualizing or photographing regions of varying density in a field of **flow.**

screaming. A form of **combustion instability,** especially in a **liquid-propellant rocket engine,** of relatively high frequency and characterized by a high-pitched noise.

scrub. To cancel a scheduled firing, either before or during **countdown.**

secondary cosmic rays. Secondary **emission** in the **atmosphere** stimulated by **primary cosmic rays.** See **air shower.**

seeing. A blanket term long used by astronomers for the disturbing effects produced by the **atmosphere** upon the image quality of an observed celestial body. Also called *astronomical seeing.*

selenocentric. Related to the center of the moon; referring to the moon as a center.

selenographic. **1.** Of or pertaining to the physical geography of the moon. **2.** Specifically, referring to positions on the moon measured in **latitude** from the moon's **equator** and in **longitude** from a **reference meridian.**

semicircular canals. Structures of the **inner ear,** the primary function of which is to register movement of the body in space. They respond to change in the rate of movement.

sensible atmosphere. That part of the **atmosphere** that offers resistance to a body passing through it.

sensor. **1.** The component of an instrument that converts an **input** signal into a quantity which is measured by another part of the instrument. Also called *sensing element.* **2.** The nerve endings or sense organs which receive information from the environment, from the organism, or from both.

shadowgraph. **1.** A picture or image in which steep density **gradients** in the flow about a body are made visible, the body itself being presented in silhouette. **2.** The optical method or technique by which this is done.

shield. A body of material used to prevent or reduce the passage of **particles** or **radiation.**

shock tube. A relatively long tube or pipe in which very brief high-speed gas flows are produced by the sudden release of gas at very high pressure into a low-pressure portion of the tube; the high-speed flow moves into the region of low pressure behind a shock wave.

shoran. (From *sho*rt-*ra*nge *na*vigation.) A precision electronic **position** fixing system using a **pulse** transmitter and receiver and two **transponder** beacons at fixed points.

shot. **1.** An act or instance of firing a **rocket,** especially from the earth's surface, as, *the shot carried the rocket 200 miles.* **2.** The flight of a rocket, as, *the rocket made a 200-mile shot.*

sidereal. Of or pertaining to the stars.

sloshing. The back-and-forth movement of a **liquid** fuel in its tank, creating problems of stability and control in the **vehicle.**

slug. A unit of **mass;** the mass of a free body which if acted upon by a force of 1 pound would experience an acceleration of 1 foot per square second; thus approximately 32.17 pounds.

slurry. A **suspension** of fine solid particles in a liquid.

soft radiation. Radiation absorbable by an absorber equivalent to 10 centimeters of lead or less.

solar atmospheric tide. An **atmospheric tide** due to the thermal or gravitational action of the sun.

solar cell. A **photovoltaic cell** that converts sunlight into electrical energy.

solar constant. The rate at which **solar radiation** is received outside the earth's atmosphere on a surface normal to the incident radiation and at the earth's mean distance from the sun.

solar radiation. The total **electromagnetic radiation** emitted by the sun.

solar wind. Streams of **plasma** flowing approximately radially outward from the sun.

solid propellant. Specifically, a **rocket propellant** in solid form, usually containing both fuel and oxidizer combined or mixed, and formed into a monolithic (not powdered or granulated) **grain.**

solid-propellant rocket engine. A **rocket engine** fueled with a **solid propellant.** Such motors consist essentially of a **combustion chamber** containing the propellant, and a **nozzle** for the exhaust jet, although they often contain other components, as grids, liners, etc.

sonic. **1.** In aerodynamics, of or pertaining to the speed of sound; that which moves at **acoustic velocity** as in *sonic flow;* designed to operate or perform at the speed of sound, as in *sonic leading edge.* **2.** Of or pertaining to sound, as in *sonic amplifier.*

sonic boom. A noise caused by a **shock wave** that emanates from an aircraft or other object traveling at or above **sonic velocity.**

sonic speed. **Acoustic velocity;** by extension, the speed of a body traveling at a **Mach number** of 1.

sophisticated. Complex and intricate; making use of advanced art; requiring special skills to operate.

sounding. **1.** In **geophysics,** any penetration of the natural environment for scientific observation. **2.** In meteorology, same as **upper air observation.** However, a common connotation is that of a single complete **radiosonde** observation. **3.** =**air sounding.**

sounding rocket. A **rocket** that carries aloft equipment for making observations of or from the **upper atmosphere.** See **air sounding.** Compare **probe,** sense **3.**

space. **1.** Specifically, the part of the universe lying outside the limits of the earth's atmosphere. **2.** More generally, the volume in which all celestial bodies, including the earth, move.

space-air vehicle. A vehicle operable either within or above the **sensible atmosphere.** Also called *aerospace vehicle.*

spacecraft. Devices, manned and unmanned, which are designed to be placed into an **orbit** about the earth or into a **trajectory** to another **celestial body.**

space equivalent. A condition within the earth's atmosphere that is virtually identical, in terms of a particular function, with a condition in outer space.

space medicine. A branch of **aerospace medicine** concerned specifically with the health of persons who make, or expect to make, flights into space beyond the **sensible atmosphere.**

space probe. See **probe.**

space reddening. The observed reddening, or absorption of shorter **wavelengths,** of the light from distant **celestial bodies** due to **scattering** by small particles in interstellar **space.** Compare **red shift.**

space simulator. **1.** Any device used to simulate one or more parameters of the space **environment** used for testing space systems or components. **2.** Specifically, a closed chamber

capable of approximately the vacuum and normal environments of space.

spatial. Pertaining to **space.**

spatio. A combining form meaning **space.**

specific impulse (*symbol* I_{sp}). A performance parameter of a **rocket propellant,** expressed in seconds, equal to the **thrust** F in pounds divided by the weight flow rate iv in pounds per second.

spectrum. **1.** In physics, any series of energies arranged according to **wavelength** (or **frequency**). **2.** The series of images produced when a **beam** of radiant energy is subject to **dispersion.** **3.** Short for **electromagnetic spectrum** or for any part of it used for a specific purpose as the *radio spectrum* (10 kilocycles to 300,000 megacycles). **4.** In mathematics, = **function.** **5.** In acoustics, the distribution of effective **sound pressures** or intensities measured as a function of frequency in specified frequency bands.

sputtering. Dislocation of surface atoms of a material from bombardment by high-energy atomic **particles.**

stage. **1.** A self-propelled separable element of a **rocket vehicle.** See **multistage rocket.** **2.** A step or process through which a **fluid** passes, especially in compression or expansion. **3.** A set of **stator** blades and a set of **rotor** blades in an axial-flow compressor or in a turbine; an **impeller wheel** in a radial-flow compressor.

stage-and-a-half. A **liquid-propellant rocket** of which only part of the propulsion unit falls away from the **rocket vehicle** during flight, as in the case of **booster rockets** falling away to leave the **sustainer engine** to consume remaining fuel.

standard atmosphere. **1.** A hypothetical vertical distribution of atmospheric temperature, pressure, and density which, by international agreement, is taken to be representative of the **atmosphere** for purposes of pressure altimeter calibrations, aircraft performance calculations, aircraft and rocket

design, ballistic tables, etc. The air is assumed to be devoid of dust, moisture, and water vapor and to obey the perfect gas law and the hydrostatic equation (the air is static with respect to the earth). **2.** (*abbr* **atm**). A standard unit of **atmospheric pressure,** defined as that pressure exerted by a 760-millimeter column of mercury at standard gravity (980.665 centimeters per second per second) at temperature 0° C.

stationary orbit. An **orbit** in which the **satellite** revolves about the **primary** at the angular rate at which the primary rotates on its axis. From the primary, the satellite thus appears to be stationary over a point on the primary.

stoichiometric. Of a mixture of chemicals, having the exact proportions required for complete chemical combination, applied especially to combustible mixtures used as **propellants.**

subatomic particle. Any **particle** of less than atomic mass; e.g., the electron, proton, and neutron, also called *atomic particle.*

subsonic. In aerodynamics, of or pertaining to, or dealing with speeds less than **acoustic velocity** as in *subsonic aerodynamics.*

sudden ionospheric disturbance (*abbr SID*). A complex combination of sudden changes in the condition of the **ionosphere** and the effects of these changes.

sunspot. A relatively dark area on the surface of the sun consisting of a dark central umbra surrounded by a penumbra which is intermediate in brightness between the umbra and the surrounding **photosphere.**

sunspot cycle. A cycle with an average length of 11.1 years but varying between about 7 and 17 years in the number and area of **sunspots,** as given by the **relative sunspot number.** This number rises from a minimum of 0 to 10 to a maximum of 50 to 140 about 4 years later, and then declines more slowly.

supersonic. Of or pertaining to, or dealing with, speeds greater than the **acoustic velocity.** Compare with **ultrasonic.**

sustainer engine. A **rocket engine** that maintains the velocity of a rocket vehicle once it has achieved its programed velocity by use of **booster** or other engine.

sweep. The motion of the visible dot across the face of a **cathode-ray tube,** as a result of deflections of the **electron beam.**

synchronous satellite. An equatorial west-to-east **satellite** orbiting the earth at an altitude of approximately 35,900 kilometers at which altitude it makes one **revolution** in 24 hours, synchronous with the earth's **rotation.**

synergic curve. A curve plotted for the ascent of a **rocket vehicle** calculated to give the vehicle an optimum economy in fuel with an optimum velocity.

tektite. Small glassy bodies containing no crystals, composed of at least 65 percent silicon dioxide, bearing no relation to the geological formations in which they occur, and believed to be of extraterrestrial origin.

telemetry. The science of measuring a quantity or quantities, transmitting the results to a distant station, and there interpreting, indicating, and/or recording the quantities measured.

terminator. The line separating illuminated and dark portions of a celestial body, as the moon, which is not self-luminous.

terrestrial. Of or pertaining to the earth.

thermal. **1.** Of or pertaining to **heat** or **temperature.** **2.** A vertical air current caused by differential heating of the terrain.

thermodynamic. Pertaining to the flow of **heat** or to **thermodynamics.**

thermodynamics. The study of the flow of **heat.**

thermonuclear. Pertaining to a **nuclear** reaction which is triggered by particles of high **thermal energy.**

thrust. **1.** The pushing or pulling force developed by an aircraft engine or a **rocket engine.** **2.** The force exerted in any direction by a fluid jet or by a powered screw, as, *the thrust of an antitorque rotor.* **3.** (*symbol F*). Specifically, in rocketry, $F=mv$ where m is propellant mass flow and v is exhaust velocity relative to the vehicle. Also called *momentum thrust.*

torr. Provisional international standard term to replace the English term *millimeter of mercury* and its abbreviation *mm of Hg* (or the French *mm de Hg*).

tracking. **1.** The process of following the movements of an object. This may be done by keeping the **reticle** of an optical system or a **radar beam** on the object, by plotting its **bearing** and distance at frequent intervals, or by a combination of the two. **2.** A motion given to the major **lobe** of an **antenna** so that a preassigned moving target in space remains in the lobe's field as long as it is within viewing range.

trajectory. In general, the path traced by any body moving as a result of an externally applied force, considered in three dimensions.

transducer. A device capable of being actuated by **energy** from one or more **transmission** systems or media and of supplying related energy to one or more other transmission systems or media, as a microphone, a thermocouple, etc.

transfer orbit. In interplanetary travel, an elliptical **trajectory** tangent to the **orbits** of both the departure planet and the target planet. Also called *transfer ellipse.*

transit. **1.** The passage of a **celestial body** across a **celestial meridian,** usually called *meridian transit.* **2.** The apparent passage of a celestial body across the face of another celestial body or across any point, area, or line. **3.** An instrument used by an astronomer to determine the exact instant

of meridian transit of a celestial body. **4.** A reversing instrument used by surveyors for accurately measuring horizontal and vertical angles; a theodolite which can be reversed in its supports without being lifted from them.

translunar. Outside the moon's orbit about the earth.

transponder. A combined **receiver** and **transmitter** whose function is to transmit signals automatically when triggered by an **interrogator.**

T-time. Any specific time, minus or plus as referenced to zero or launch time, during a **countdown** sequence that is intended to result in the firing of a rocket propulsion unit that launches a rocket vehicle.

ullage. The amount that a container, such as a fuel tank, lacks of being full.

ultrasonic. In acoustics, of or pertaining to **frequencies** above those that affect the human ear; i.e., more than 20,000 vibrations per second.

ultraviolet radiation. Electromagnetic radiation of shorter wavelength than **visible radiation;** roughly, radiation in the wavelength interval from 100 to 4000 angstroms. Also called *ultraviolet.*

umbilical cord. Any of the servicing electrical or fluid lines between the ground or a tower and an uprighted **rocket vehicle** before the **launch.** Often shortened to *umbilical.*

upper air observation. A measurement of atmospheric conditions aloft, above the effective range of a surface weather observation. Also called *sounding, upper air sounding.* See **radiosonde.**

Van Allen belt, Van Allen radiation belt. (For James A. Van Allen, 1915– .) The zone of high-intensity **particulate radiation** surrounding the earth beginning at altitudes of approximately 1000 kilometers.

vehicle. Specifically, a structure, machine, or device, such as an aircraft or **rocket,** designed to carry a burden through air or space; more restrictively, a **rocket vehicle.**

vernier engine. A rocket engine of small thrust used primarily to obtain a fine adjustment in the **velocity** and **trajectory** of a **rocket vehicle** just after the thrust cutoff of the last **sustainer** engine, and used secondarily to add thrust to a booster or sustainer engine. Also called *vernier rocket.*

visible radiation. **Electromagnetic radiation** lying within the wavelength interval to which the human eye is sensitive, the spectral interval from approximately 0.4 to 0.7 micron (4000 to 7000 angstroms).

waveguide. A system of boundaries capable of guiding waves.

weight (*symbol* ***w***). **1.** The **force** with which a body is attracted toward the earth. **2.** The product of the **mass** of a body and the **acceleration** acting on a body.

weightlessness. A condition in which no acceleration, whether of **gravity** or other force, can be detected by an observer within the **system** in question.

whistler. A **radiofrequency** electromagnetic **signal** generated by some lightning discharges.

X-ray. **Nonnuclear electromagnetic radiation** of very short **wavelength,** lying within the interval of 0.1 to 100 angstroms (between gamma rays and ultraviolet radiation). Also called *X-radiation, Roentgen ray.*

yaw. **1.** The rotational or oscillatory movement of an aircraft, rocket, or the like about a vertical axis. **2.** The amount of this movement; i.e., the angle of yaw. **3.** To cause to **rotate** about a vertical axis. **4.** To **rotate** or **oscillate** about a vertical axis.

zero-g = weightlessness.

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